

I. Overview

Our project is a vending machine monitoring system. The system reads audit data from the vending machine using the DEX (Data Exchange) interface. The audit data will provide information that will be used to determine if the machine needs service. This could include items being sold out, overflow or running out of cash or coins, or general machines problems.

Our system will use the customer to communicate this information back to the distribution company. Using an LCD (liquid crystal display) and keypad module on the outside of the machine, the customer will be alerted with a flashing LED and message to call the telephone number and enter the displayed code to receive a free vend from the machine. This will only be triggered when the machine needs service. The user will call into a phone system which will check the code, and provide a promotional code to enter into the keypad on the device which will enable the free vend.

II. Components

The components of our system include a development board from SJJ Micro, an LCD, and a keypad. The LCD and keypad are part of the external module located on the front of the vending machine. The vending machine will be mounted inside an enclosure inside the vending machine door. The vending machine used for our testing was a Dixie Narco model 276E SII Pepsi machine. The machine has seven columns and is fully functional.

The development board contains an ARM9 microprocessor (Cirrus Logic EP9302) along with various features, including serial (RS-232) communication. Also included are various header connectors for interfacing with pins from the microprocessor. We used the SPI port from the microprocessor by connecting some of the header pins to a daughter board which enabled use of the LCD and keypad.



Figure 1- Picture used from http://www.emacinc.com/sbc_microcontrollers/ipac_9302.htm

The external module contains the LCD, LED (light emitting diode) and button keypad. The LCD is a standard 80 character (4 rows x 20 columns) screen. The keypad has 12 buttons. The pound (#) key is used as enter for the customer (end user). The asterisk (*) is designated as the backspace key. The LCD and keypad interface with a daughter board, shown in figure 2.



Figure 2 - External Module (User Interface), front and back view of device

III. Installation

A. LCD & Daughter Board

Figure 3 below shows how the LCD, daughter board, and LED are connected. To connect the LCD and daughter board, place the daughter board face up with pin header X2 on top of the LCD face down. When the pins align, solder each pin. Then, connect a 150Ω resistor to pin 15 on the LCD to limit the current drawn by the LED. Then, connect a red panel-mount LED for the resistor and pin 16 on the LCD. Pin 15 is +5V and pin 16 is the ground pin.

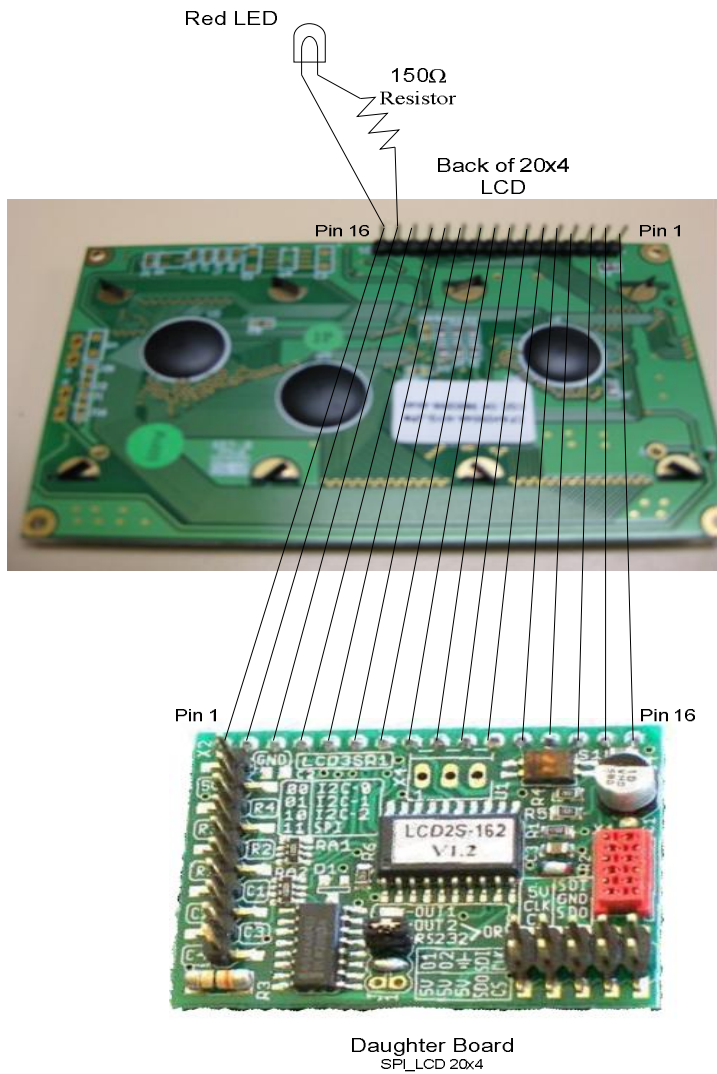


Figure 3 - Schematic of the daughter board, LCD, and LED connections

B. Keypad, Daughter Board, and Development Board

Figure 4 below shows how the development board, daughter board, and keypad are connected. Connect the keypad pins to the daughter board pins on header X2 as shown below. Pin 10 on header X2 is not used on the daughter board, because this uses a 4x3 keypad meaning there is not a fourth column (i.e. a 4 x 4 keypad) of buttons on the keypad. Also, pins 1 and 2, ground and 5V respectively, on header X2 aren't used. This is because the power and ground are already taken care of by the connection between the development board header X2 and the daughter board header X3. Connect those as shown below also.

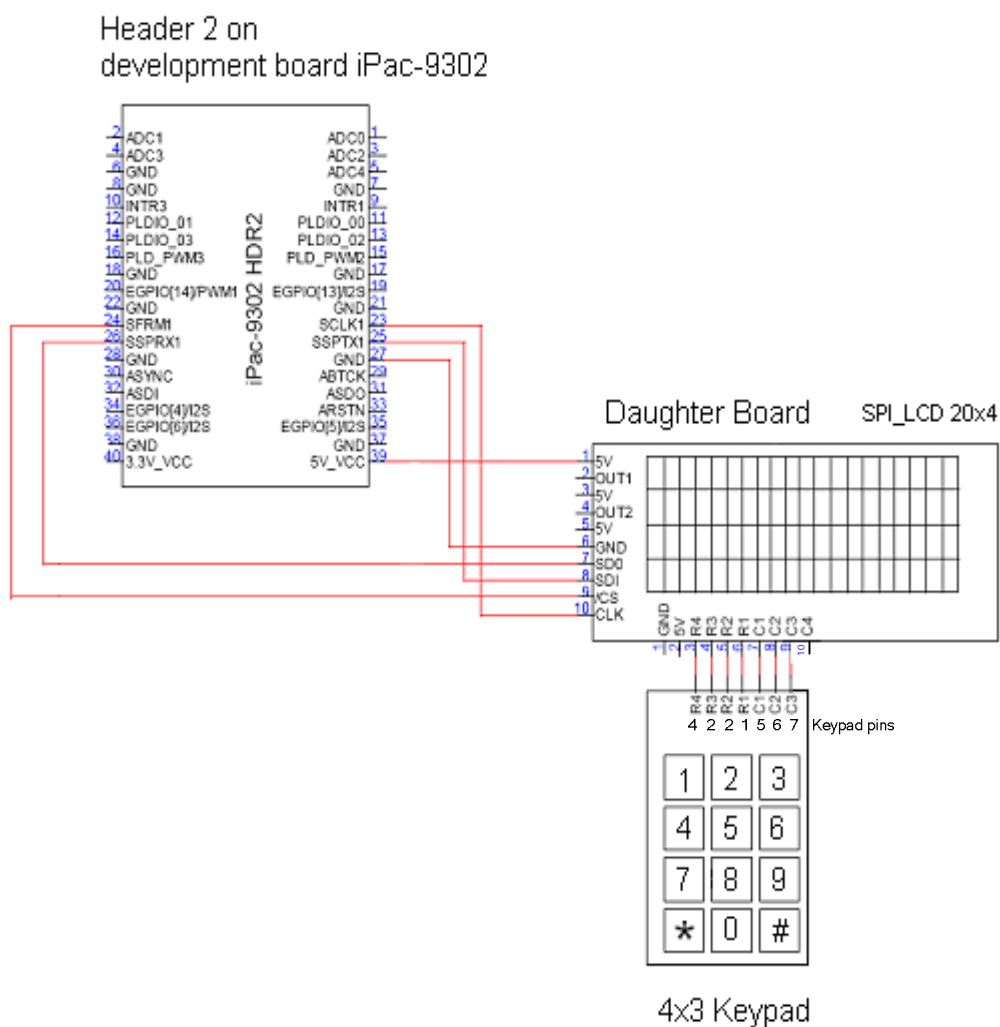


Figure 4 - Schematic of the daughter board, keypad, and development board

C. Power Connection

The development board needs power so there has to be a connection from the development board to the control board in the vending machine. The coin changer interface (P7) header is used to power the development board. Connect pins 3 and 4 on the coin changer interface P7 to header 4 pins 1 and 2 respectively, as shown below in figure 5. Figure 6 shows that pin 4 on P7 will have two connections (the purple and black wires) to it once pin 2 on header 4 from the development board is connected to it.

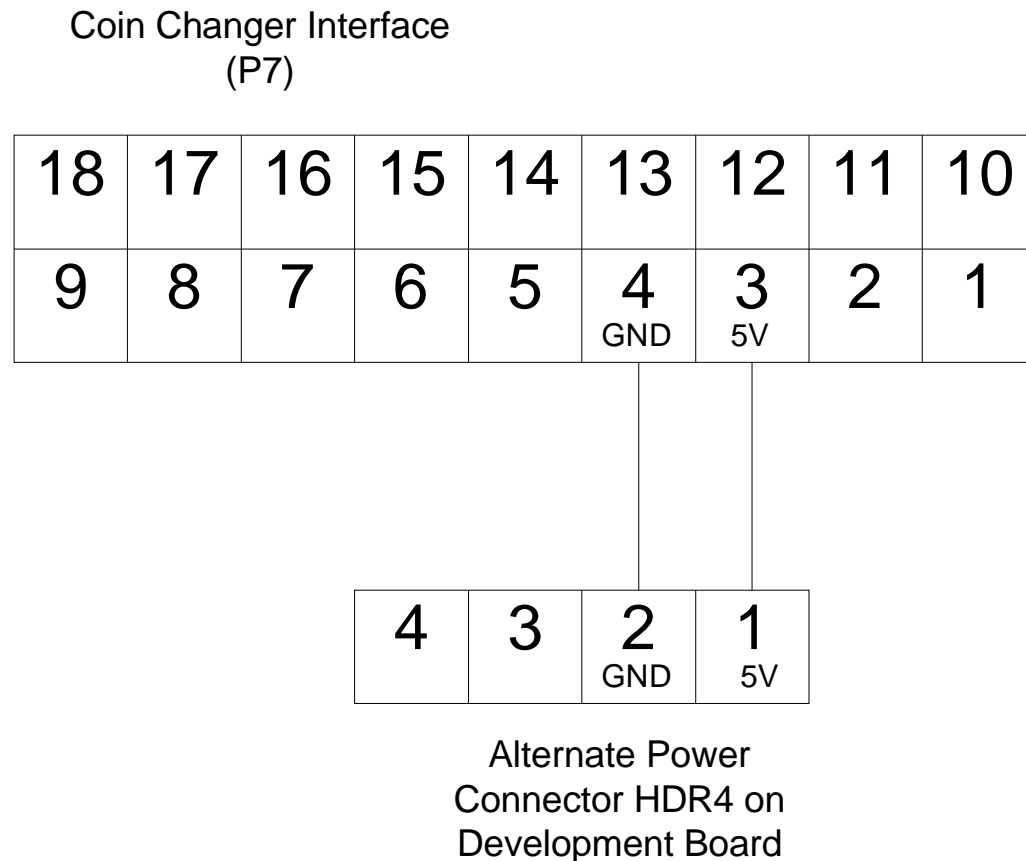


Figure 5 - Power Connections



Figure 6 - Coin Changer Interface (P7) with power connections

IV. General Operation

Shown below are the different screen shots that should display during operation. When there is an inventory or warning status that the vending machine owner should be aware of, the device will blink an LED/button. Consumers who press the button will be given a phone number to call and an encrypted number to enter. Upon receiving a valid encrypted number, the system will send back a code that the user can enter into the device to receive a free item from the vending machine.



Figure 7 - Screen shown during DEX audit

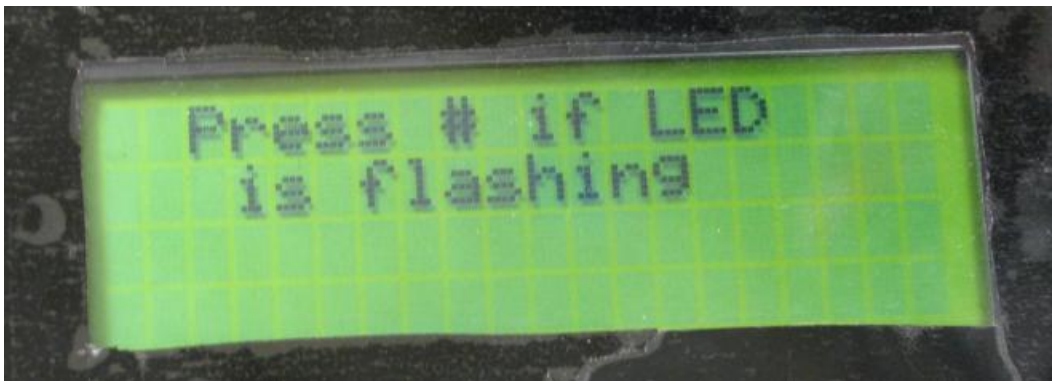


Figure 8 - Screen shown when there is an inventory problem



Figure 9 - Screen after # is pushed giving the phone number and machine ID



Figure 10 - Screen giving secret code and place to enter redemption code



Figure 11 - Screen shown when code is verified



Figure 12 - Screen shown when code is incorrect

V. Maintenance / Troubleshooting

Problem	Parts affected	Solution
LCD does not power up	LCD	<ul style="list-style-type: none">• Check the connections from LCD to iPac-9302• Check if LCD is damaged
LCD displays black blocks	LCD	<ul style="list-style-type: none">• Replace the LCD
LED does not blink	LED	<ul style="list-style-type: none">• Check the connections on the LCD2S• Replace LED
Keypad does not respond	Keypad	<ul style="list-style-type: none">• Check the connections on the LCD2S• Set the keypad debounce time to a lower value• Replace Keypad
DEX Communication does not complete	Serial to Audio Connector	<ul style="list-style-type: none">• Secure the connector at both ends• Replace the connector
	RS232 port	<ul style="list-style-type: none">• Check if the RS232 port on iPac-9302 is working
	Audio port	<ul style="list-style-type: none">• Check if the Audio port on the Vending Machine is working
	Vending Machine	<ul style="list-style-type: none">• Check for bottles jammed in the machine